Southern Forest Experiment Station

Research Note

SO-264

1981

Thinning and Pruning Influence Glaze Damage in a Loblolly Pine Plantation

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SUMMARY

An old-field plantation was thinned and pruned at age 11 and again at age 14 to 4 basal area levels and 3 crown percent levels. A survey was made to determine how damage by an ice storm at age 15 was influenced by treatment. Severe damage was heaviest in the densest stands and in stands with the shortest crowns, while the percent of stand destroyed was least under the heaviest thinning and lowest pruning. However, basal area and stems/acre in remaining growing stock were greatest under the lightest thinning and lowest pruning.
Additional keywords: *Pinus taeda* L., freezing rain, understocking.

INTRODUCTION

Cultural practices such as heavy thinning and high pruning can markedly shorten sawtimber rotations and enhance the value of the product. But they can also have an unfavorable effect on a stand's resistance to ice damage.

The belt of greatest severity and frequency of glaze storms extends from north-central Texas to southern New England; ice 0.25 to 0.50 inches in radial thickness on needles, branches, and utility wires may be expected once every 3 years somewhere in this belt. Nearly all the country east of the Rocky Mountains (except the southern half of Louisiana, Mississippi, Alabama, Georgia, South Carolina, and all of Florida) can expect such thicknesses somewhere once in 6 years; and deposits of 1 radial inch or more have been recorded in most of this area and on the Louisiana coast (Bennett 1959).

Loblolly pine is less resistant than shortleaf and more resistant than slash pine to injury by glaze and snow (Wakeley 1954).

The most resistant stands are those with wide, uniform spacing—stands frequently thinned so as to maintain sturdy boles and compact, symmetrical crowns; recently thinned stands tend to be susceptible to glaze injury for a few years after thinning; in the long run, thinning results in sturdier stems and stronger branches, but in the short run it robs residual trees of mutual support (Brender and Romancier 1960).

A glaze storm heavily damaged thinned and unthinned stands in southern Arkansas in January 1974. The storm provided an opportunity to study how thinning and pruning intensity affect resistance of a 15-year-old loblolly pine plantation to ice loading on foliage and branches.

METHODS

The plantation is on an old cotton field near Monticello, Arkansas[1]. It was thinned and pruned at age 11 (12 years from seed germination) and again at age 14—4 years before and 1 year before the storm. Four levels of thinning and three of pruning were applied factorially and replicated 3 times in randomized complete blocks. Treatments were applied to 0.4-acre square gross plots; a 0.1-acre, square measurement plot was established in the center of each gross plot.

Thinning at age 11 to four levels (very light, light, heavy, and very heavy) left basal areas of 100, 80,

[1]Land and technical assistance were provided by the Crossett Division, Georgia-Pacific Corporation.

60, or 40 ft²/acre in merchantable trees (≥4.6 inches dbh containing ≥ two 63-inch bolts to a 3-in top dib). Trees smaller than this were considered submerchantable and were removed in the initial thinning. Where possible, thinning was mainly from below. But the need to achieve uniform spacing and to remove forked and crooked trees, wolf trees, and trees with fusiform rust stem galls forced cutting of many dominant and codominant trees. So did the reduction of basal area to 40 ft²/acre. Dominant and codominant trees at age 11 averaged 37 ft in total height and had a live crown length of 22 ft. After thinning, live crowns were reduced by pruning to 52, 41, or 37 percent of total height (low, medium, and high pruning levels, respectively).

Following inventory at age 14, thinning and pruning were repeated and intensified. Residual basal area levels were 90, 70, 50, or 30 ft²/acre, and crown lengths were pruned to 55, 40, or 25 percent of total height.

After treatment at age 14, some stand attributes representative of the four thinning levels were:

Thinning level	Trees/acre	Quadratic mean dbh	Mean total height of dominants and codominants
ft²/acre	*number*	*inches*	*feet*
90	273	7.8	43
70	199	8.1	44
50	123	8.6	45
30	68	9.0	44

The low level of pruning did not remove all the lower branches already killed by shading at age 14 in the lightest thinning. It did at all other levels of thinning. But even at the heaviest thinning, low pruning was very mild. High pruning, however, was severe (fig. 1).

A complete inventory of the plots was made 1 month after the storm. Glaze injuries were tallied according to severity under three headings: loosening of roots in soil, stem bending, and loss of crown. Trees with ≥50 percent of the live crown lost or with the bole bent or butt deflected ≥ 45° from vertical were considered severely damaged and were marked for salvage. All other living trees were retained as growing stock.

Treatment-associated differences in proportion of stand destroyed and in density of remaining growing stock were examined through analysis of variance at the .05 level. Duncan's Multiple Range Test was used to evaluate differences in main effects of thinning and pruning when the T × P interaction was not significant.

RESULTS AND DISCUSSION

Crown loss was the principal kind of injury. Stem bending and root springing account for < 5 percent of the injured trees. Some crown loss resulted from breaking branches, but a substantial majority was caused by stem break, within or below the live crown (fig. 2). Mean stem diameter at the break was 3.0 inches (range 1.5 to 3.7 inches by treatment).

Crown loss was heaviest in the high pruning treatments and was lightest in the two heaviest thinning treatments (table 1). Forty-four percent of the basal area in high-pruning plots, all thinning levels combined, was in severely damaged trees. In high-pruning plots thinned to 70 ft² or 90 ft², 50 to 60 percent of the stand was lost. The mean for high pruning was significantly different from the means for medium and low pruning; the means for the 30-ft², 50-ft², and 90-ft² thinning levels, all prunings combined, were significantly different.

Severe damage, in numbers of trees/acre, was centered in the 7-inch and 8-inch dbh classes in the very light and light thinning treatments (table 2). In the very heavy and heavy thinnings, severe damage occurred more frequently in the 9-inch than in the 7-inch class.

Table 1.—*Fraction of stand basal area in severely damaged trees*

Pruning level	Thinning level				Pruning means
	very heavy	heavy	light	very light	
	percent				
High	28	39	50	60	44b[1]
Medium	3	24	20	36	21a
Low	8	9	18	18	13a
Thinning means	13a	24b	29bc	38c	26

[1]Means followed by the same letter, within a row or a column, are not significantly different.

Even though the very light thinning plots sustained a greater percentage loss than the very heavy and heavy thinning treatments combined, they contained more growing stock after the storm (table 3). The heavy thinning plots contained a greater manageable basal area than did the very heavy. The T × P interaction was not significant. Uniform levels of basal area within thinning treatments no longer existed, because pruning level affected storm damage. All three pruning means were significantly different.

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Figure 1.—*In many trees, high pruning left only 2 annual whorls and the leader.*

Figure 2.—*Many trees suffered stem breakage below the crown.*

Table 2.—*Diameter distribution of trees severely damaged by the glaze storm*

Thinning level	Pruning level	Dbh (inches) 5	6	7	8	9	10	Total
		trees/acre						
Very heavy	High	0	0	3	7	13	0	23
	Medium	0	0	0	3	0	0	3
	Low	0	0	0	0	6	0	6
Heavy	High	0	7	10	20	10	10	57
	Medium	0	0	3	10	13	7	33
	Low	0	0	3	3	7	7	13
Light	High	0	13	73	10	17	4	117
	Medium	0	7	13	20	7	0	47
	Low	0	0	13	17	7	3	40
Very light	High	0	13	47	60	33	7	160
	Medium	7	17	40	26	20	3	113
	Low	0	7	13	27	7	0	54

Table 3.—*Basal area remaining in undamaged and lightly damaged trees after the glaze storm*

Pruning level	Thinning level very heavy	heavy	light	very light	Pruning means
	ft^2/*acre*				
High	23	32	37	37	32a[1]
Medium	32	42	60	63	49b
Low	31	51	64	81	57c
Thinning means	29a	42b	54c	60c	46

[1]Means followed by the same letter, within a row or a column, are not significantly different.

Table 4.—*Diameter distribution of undamaged and lightly damaged trees/acre after the glaze storm*

Thinning level	Pruning level	Dbh (inches)							Total
		6	7	8	9	10	11	12	
		trees/acre							
Very heavy	High	0	7	13	7	20	3	0	50
	Medium	0	0	7	17	20	13	3	60
	Low	0	3	10	14	13	20	0	60
Heavy	High	0	0	10	17	26	10	0	63
	Medium	0	3	13	40	27	7	0	90
	Low	0	6	27	50	20	10	0	113
Light	High	0	33	40	27	3	0	0	103
	Medium	0	13	63	57	17	0	0	150
	Low	0	7	50	40	23	17	3	140
Very light	High	14	13	40	27	3	3	0	100
	Medium	10	27	67	43	13	7	0	167
	Low	10	67	100	33	13	3	0	226

Stand density in trees/acre remaining after the storm followed a pattern similar to that of basal area (table 4). All four thinning means were significantly different when all pruning levels were combined. All three pruning means were significantly different when all thinning levels were combined. The very light thinning plots contained twice as much basal area (table 3) and nearly three times as many trees/acre (table 4) as the very heavy thinning plots, all pruning levels combined. In the very heavy thinning plots, 92 percent of the trees/acre were in the 8- through 11-inch dbh classes. In the heavy thinning plots, the 8- through 11-inch classes contained 96 percent of the trees/acre. Seventy percent of the trees in the light thinning plots were in the 7- and 8-inch classes. The 7- through 10-inch classes included 91 percent of the trees in the high pruning, 91 percent in the medium, and 88 percent in the low pruning treatments, all thinning levels combined.

Wahlenberg (1960) stated: "In general, natural stands appear just as susceptible to injury from ice as are planted stands properly spaced and thinned. Ice damage is found in both open-grown and dense stands, but the trees that show the effects of crowding are somewhat more susceptible. Although dense stands tend to suffer the highest percentage of loss, they are likely to emerge with the most undamaged trees. This is the situation where calm weather outlasts the ice overload".

Results of this study indicate that plantations pruned to a 25-percent live crown are more likely to lose half or more of the remaining crown in a glaze storm of this severity than are stands of similar basal area, within the limits of this study, pruned to a 40- or 55-percent live crown. This does not necessarily indicate that high pruning uces a stem's mechanical strength more than medium or low pruning (although it could be true). It does indicate that mean stem diameter at breaking point is more likely to be at or below the crown midpoint in a highly pruned tree than in a similar tree given low or medium pruning.

Trees in this study appeared to be very severely damaged, particularly in dense stands with high pruning. This does not mean that plantations so damaged are immediate candidates for liquidation. Loblolly pine, more than any other southern pine, recovers rapidly from understocking and vigorously exploits available space. Some of the intensive-management plots in the *Sudden Sawlogs* study (Burton 1976) contained only 37 ft^2/acre in 92 trees/acre at age 16; 3 years later their basal area was 61 to 63 ft^2/acre.

LITERATURE CITED

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ERRATUM: 2nd col., 1st par. Sentence, "This does not..." should read,"This does not necessarily indicate that high pruning reduces a stem's..."